

**Object-Oriented Software Engineering  
Re-exam, 2012  
(Also Object-Oriented Analysis, Design and Programming,  
Re-exam, 2012)**

**Medialogy, 4<sup>th</sup> Semester, Aalborg**

**Thursday 23 August 2012, 09.00 – 12.00**

**Instructions**

You have 3 hours to complete this examination.

Neither written material nor electronic equipment may be brought into the examination room.

There are 12 questions and each question is worth 10 marks. The maximum possible score is 120 marks.

If you are taking this examination for OOSE, you must get at least 50 marks to pass.

If you are taking this examination for OOADP, you must get at least 45 marks to pass.

Note that a number at the beginning of any line in a program listing indicates the number of that line and is not part of the program itself.

Please write your answers in pencil or black or blue ink ONLY.

**DO NOT TURN OVER UNTIL INSTRUCTED TO DO SO!**

### Question 1

- a. Brooks (1975) has suggested that the time taken to complete a software project does not necessarily decrease if more people are working on the project. Explain why this is so. (4 marks)
- b. Explain the meaning of the following three terms:
  - i. *encapsulation* (2 marks)
  - ii. *modularity* (2 marks)
  - iii. *context dependencies* (2 marks)

## Question 2

a. Write down the output of the following Java program. (4 marks)

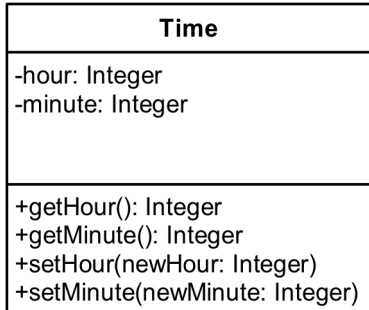
```
1 package dk.aau.medialogy.med4.oose.reexam2012;
2
3 public class IntsAndFloats {
4     public static void main(String[] args) {
5         System.out.println(3/2);
6         System.out.println(3.0/2);
7         System.out.println(5+5+"5");
8         System.out.println("5"+5+5);
9     }
10 }
```

b. Write down the output of the following Java program. (6 marks)

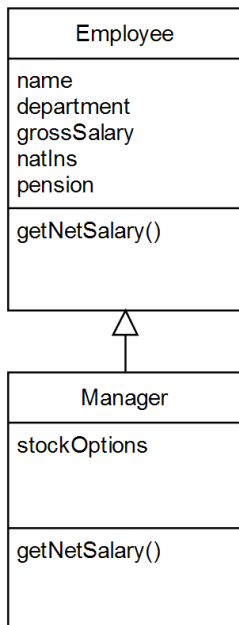
```
1 package dk.aau.medialogy.med4.oose.reexam2012;
2
3 public class Loops {
4     public static void main(String[] args) {
5         for(int i = 0, j = 10; i*j >= 0; i += 2, j -= 2) {
6             if (j > 0)
7                 System.out.println(i % j);
8             else
9                 System.out.println(i+", "+j);
10        }
11    }
12 }
```

### Question 3

- a. Explain the difference between an object's *private* and *public interface*. (2 marks)
- b. The following UML class diagram describes a class called Time. Study the diagram and answer the questions that follow it.



- i. How many private attributes does the Time class have? (1 mark)
- ii. How many public attributes does the Time class have? (1 mark)
- iii. What is the selector of the setMinute operation? (1 mark)
- iv. What is the visibility of the getMinute operation? (1 mark)
- v. What is the signature of the setHour operation? (1 mark)
- c. Study the following UML class diagram and answer the questions that follow it.

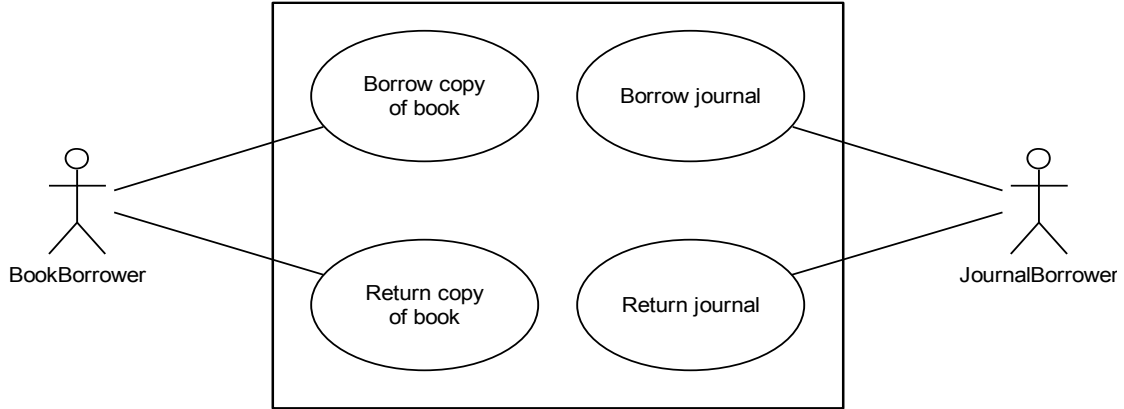


- i. How many attributes does a Manager object have (assuming the diagram shows all of them)? (1 mark)
- ii. In the Manager class, is the getNetSalary operation *overloaded* or *overridden*? (1 mark)
- iii. Is Manager a subclass or a superclass of Employee? (1 mark)

**Question 4**

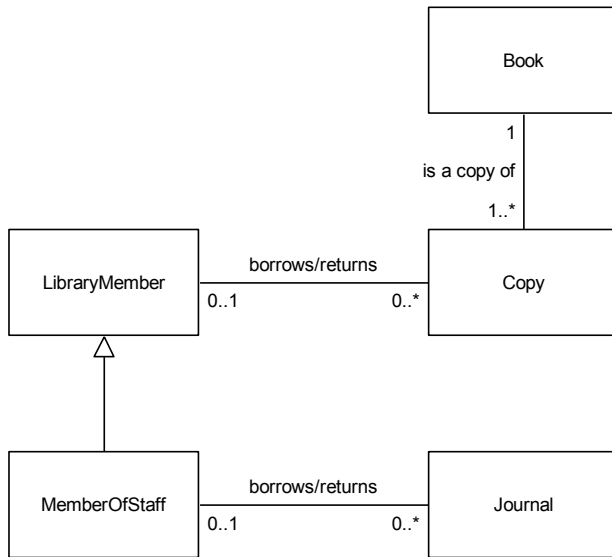
a. Name the two basic types of UML model and give one example of each type. (4 marks)

b. Study the following diagram and answer the questions that follow it.



- i. What kind of thing is BookBorrower? (1 mark)
- ii. What kind of thing is the ellipse labelled “Return copy of book”. (1 mark)
- iii. What does the large rectangle represent that contains the 4 ellipses? (1 mark)

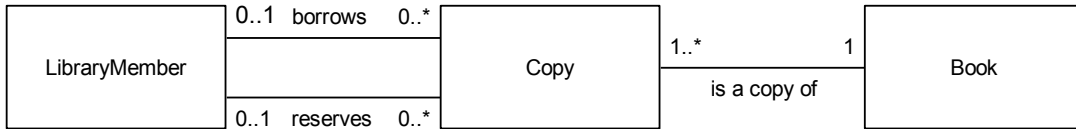
c. Study the following diagram and answer the questions that follow it.



- i. What kind of UML diagram is this? (1 mark)
- ii. What does the arrow from MemberOfStaff to LibraryMember indicate? (2 marks)

**Question 5**

a. Study the following UML diagram and answer the questions that follow it.



- i. What kind of diagram is this? (1 mark)
- ii. Is LibraryMember associated with Book? (1 mark)
- iii. How many Copy objects are associated with each Book object? (1 mark)

b. Study the following two UML diagrams and answer the questions that follow them.

DIAGRAM A:

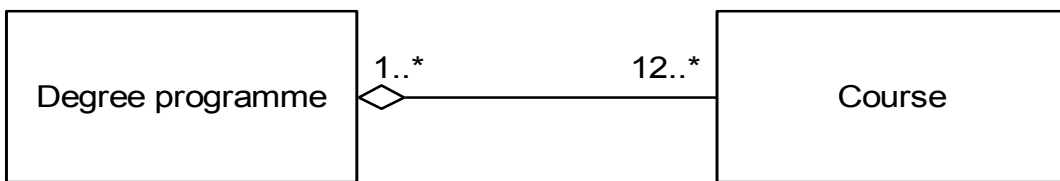
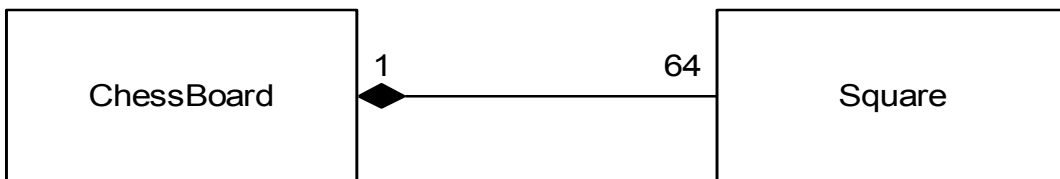
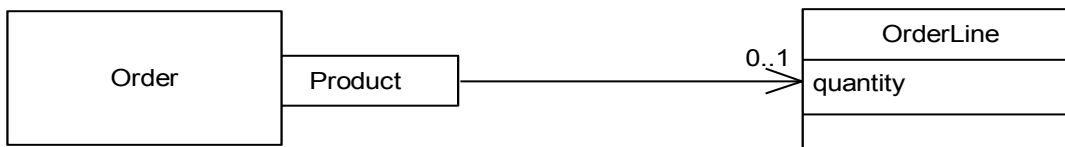


DIAGRAM B:



- i. Which of the two diagrams represents *composition*? (1 mark)
- ii. What special type of association does the other diagram represent? (1 mark)
- iii. If a ChessBoard object is destroyed, what happens to the Square objects that are associated with it? (1 mark)
- iv. How many different Degree programmes can each Course be associated with? (1 mark)

c. Study the following UML diagram and answer the questions that follow it.



- i. How many OrderLines can an Order have? (1 mark)
- ii. How many OrderLines can be associated with each Product? (1 mark)
- iii. Is 'quantity' an attribute or an operation? (1 mark)

### Question 6

a. Write down the output of the following Java program. (4 marks)

```
1 package dk.aau.medialogy.med4.oose.reexam2012;
2
3 public class Q6 {
4
5     static class Point {
6         int x, y;
7
8         public String toString() {
9             return "("+x+","+y+")";
10        }
11    }
12
13    public static void main(String [] args) {
14        Point p = null;
15        Point q = new Point();
16        q.x = 1;
17        q.y = 2;
18        p = q;
19        p.x *= 2;
20        p.y *= 2;
21        System.out.println(q);
22        q = null;
23        System.out.println(p);
24    }
25 }
```

*Question continued on next page*

b. Study the following code and answer the questions that follow it.

```
1 package dk.aau.medialogy.med4.oose.reexam2012;
2
3 public class Q6b {
4     static class Animal {
5         int age;
6         String name;
7
8         Animal(int age, String name) {
9             this.age = age;
10            this.name = name;
11        }
12
13        public String toString() {
14            return name+" (" +age+" years old)";
15        }
16    }
17
18    static class Cat extends Animal {
19        String colour;
20
21        Cat(int age, String name, String colour) {
22            super(age, name);
23            this.colour = colour;
24        }
25    }
26
27    public static void main(String[] args) {
28        Animal a = new Animal();
29        Animal b = new Animal(5, "Fred");
30        Cat c = new Cat(4, "Albert", "Brown");
31        System.out.println(b);
32        System.out.println(c);
33    }
34 }
```

i. Explain what is causing the error in line 28 and how this problem could be solved. (4 marks)

ii. Write down what this program would output if line 28 were commented out. (2 marks)



### Question 7

a. In the following program, what is causing the error in line 7? (2 marks)

```
1 package dk.aau.medialogy.med4.oose.reexam2012;
2
3 public class Q7a {
4     static final int a = 7;
5
6     public static void main(String[] args) {
7         a = 8;
8     }
9 }
10
```

b. In the following program, what is causing the error in line 16? (2 marks)

```
1 package dk.aau.medialogy.med4.oose.reexam2012;
2
3 public class Q7b {
4     abstract class A {
5         int x, y;
6         abstract int sum(int x, int y);
7     }
8
9     class B extends A {
10        int sum(int x, int y) {
11            return x + y;
12        }
13    }
14
15    public static void main(String[] args) {
16        A a = new A();
17        B b = new B();
18    }
19 }
```

*Continued on next page*

c. Write down the output of the following Java program. (2 marks)

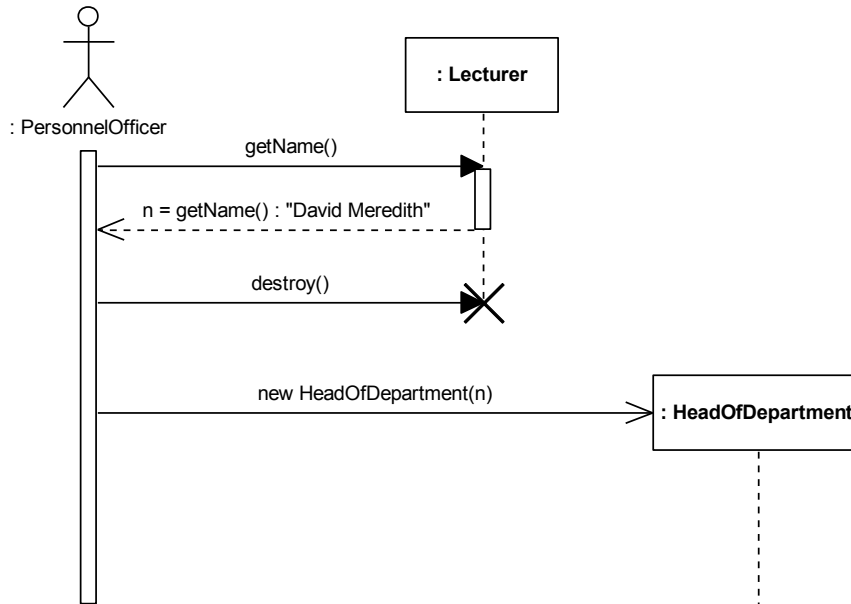
```
1 package dk.aau.medialogy.med4.oose.reexam2012;
2
3 public class Q7c {
4
5     static void leap2() throws Exception {
6         throw new Exception("leap2 message");
7     }
8
9     static void leap() throws Exception {
10        try {
11            leap2();
12        } catch(Exception e) {
13            throw new Exception("leap message and "+e.getMessage());
14        }
15    }
16
17    public static void main(String[] args) {
18        try {
19            leap();
20        } catch(Exception e) {
21            System.out.println(e.getMessage());
22        }
23    }
24 }
```

d. If you wanted to store a collection of points in lexicographical order without duplication, would you use an ArrayList or a TreeSet? (1 mark) Why? (1 mark)

e. If you wanted to store a list of floating point numbers being generated by a sensor in the order that they are received would it be better to use an ArrayList or a TreeSet? (1 mark) Why? (1 mark)

### Question 8

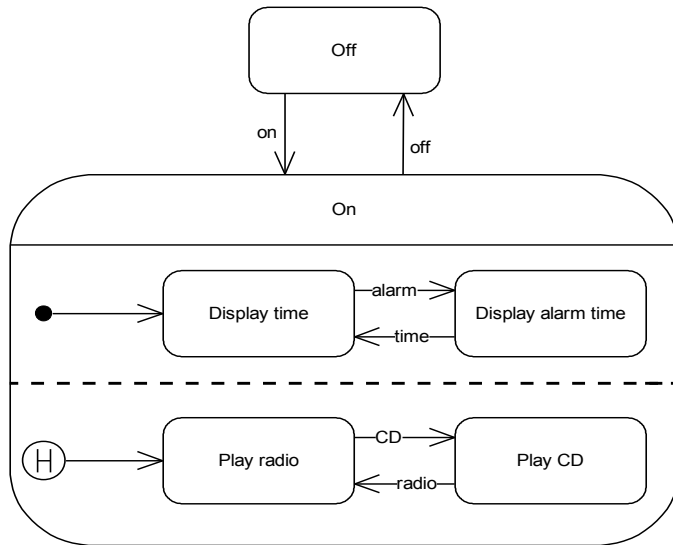
Study the following diagram and answer the questions that follow it.



- What kind of diagram is this? (1 mark)
- What is the name of the PersonnelOfficer? (1 mark)
- What is the name of the Lecturer type object to which the `getName` message is sent? (1 mark)
- In which class is the `getName()` method defined (1 mark) and what is the value returned by this method to the PersonnelOfficer (1 mark)?
- What does the dotted line signify that descends from the box labelled “:Lecturer”? (1 mark)
- What is the meaning of the cross at the bottom of the dotted line in part iii. (1 mark)
- Two of the message arrows have solid arrow heads while the third has an open “stick” arrow head. Why is this? (2 marks)
- Why is the PersonnelOfficer represented by a stick figure, whereas the Lecturer object is represented by a box? (1 mark)

### Question 9

Study the following diagram and answer the questions that follow it.



- What kind of diagram is this? (1 mark)
- What does the circle labelled 'H' mean? (2 marks)
- Is it possible for the object described by the diagram to be displaying the time and the alarm time simultaneously? (1 mark)
- Is it possible for the object described in the diagram to be playing the radio and the CD simultaneously? (1 mark)
- Is it possible for the object described in the diagram to be playing a CD and displaying the alarm time simultaneously? (1 mark)
- Describe the state that the device is in when it is switched on. (2 marks)
- Can the device be switched off when it is displaying the alarm time? (1 mark)
- According to the diagram, what event must occur in order for the device to transition from playing a CD to playing the radio? (1 mark)

### Question 10

Study the following code and answer the questions that follow it.

```
1 package dk.aau.create.med8.mp;
2
3 public class Threads {
4
5     public static void main(String[] args) {
6         Thread thread1 = new Thread(new Runnable() {
7             public void run() {
8                 for(int i = 0; i < 5; i++) {
9                     System.out.println(i);
10                    try {
11                        Thread.sleep(10);
12                    } catch (InterruptedException e) {
13                        e.printStackTrace();
14                    }
15                }
16            }
17        });
18        Thread thread2 = new Thread(new Runnable() {
19            public void run() {
20                for(int i = 100; i > 95; i--) {
21                    System.out.println(i);
22                    try {
23                        Thread.sleep(10);
24                    } catch (InterruptedException e) {
25                        e.printStackTrace();
26                    }
27                }
28            }
29        });
30
31        thread1.setName("Thread1");
32        thread2.setName("Thread2");
33        thread1.start();
34        thread2.start();
35    }
36 }
```

- Is Runnable an interface or a class? (1 mark)
- Is Thread an interface or a class? (1 mark)
- Write down one possible output of this program? (2 marks)
- What changes would you have to make to the program to ensure that it produces the same output every time it runs? (4 marks)
- Explain briefly what happens if thread1 receives an interrupt request from some other thread. (2 marks)

## Question 11

Study the three Java classes below and answer the questions that follow them.

The MulticastServer class:

```
1 package dk.aau.create.med8.mp;
2
3 public class MulticastServer {
4     public static void main(String[] args) throws java.io.IOException {
5         MulticastServerThread t = new MulticastServerThread();
6         t.start();
7     }
8 }
```

The MulticastServerThread class:

```
1 package dk.aau.create.med8.mp;
2
3 import java.io.*;
4 import java.net.*;
5 import java.util.*;
6
7 public class MulticastServerThread extends Thread {
8
9     private DatagramSocket socket = new DatagramSocket(4445);
10
11     public MulticastServerThread() throws IOException {
12         super("MulticastServerThread");
13     }
14
15     public void run() {
16         try {
17             while (true) {
18                 byte[] buf = new Date().toString().getBytes();
19                 InetAddress group = InetAddress.getByName("230.0.0.1");
20                 DatagramPacket packet = new DatagramPacket(buf, buf.length, group, 4446);
21                 socket.send(packet);
22                 sleep(50001);
23             }
24         } catch (Exception e) {
25             socket.close();
26             return;
27         }
28     }
29 }
```

*continued*

The MulticastClient class:

```
1 package dk.aau.create.med8.mp;
2
3 import java.io.*;
4 import java.net.*;
5
6 public class MulticastClient {
7     public static void main(String[] args) throws IOException {
8         MulticastSocket socket = new MulticastSocket(4446);
9         InetAddress address = InetAddress.getByName("230.0.0.1");
10        socket.joinGroup(address);
11        DatagramPacket packet;
12        for (int i = 0; i < 5; i++) {
13            byte[] buf = new byte[256];
14            packet = new DatagramPacket(buf, buf.length);
15            socket.receive(packet);
16            String received = new String(packet.getData(), 0, packet.getLength());
17            System.out.println(received);
18        }
19        socket.leaveGroup(address);
20        socket.close();
21    }
22 }
```

- a. How many copies of the MulticastClient program can be running simultaneously? (1 mark)
- b. Which program should be started first, MulticastClient or MulticastServer? (1 mark)
- c. Does each copy of MulticastClient print out exactly the same thing? (1 mark)
- d. Describe briefly what each MulticastClient prints out (note that you do not need to write down precisely what this program prints out). (2 marks)
- e. What IP address and port number does the MulticastServer send packets to? (2 marks) What is special about the recipient identified by this IP address and port number? (1 mark)
- f. Line 11 of MulticastClient declares an object named 'packet'. What is this object used for? (2 marks)

## Question 12

Study the following Java program and answer the questions that follow it.

```
1  import java.awt.BorderLayout;
2  import java.awt.event.ActionEvent;
3  import java.awt.event.ActionListener;
4  import javax.swing.JFrame;
5  import javax.swing.JLabel;
6  import javax.swing.JTextField;
7  import javax.swing.SwingUtilities;
8
9  public class GUI extends JFrame implements ActionListener {
10
11     private static final long serialVersionUID = 1L;
12     private JTextField text = new JTextField();
13     private JLabel label = new JLabel();
14
15     public GUI() {
16         setTitle("GUI");
17         setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
18         getContentPane().add(text);
19         getContentPane().add(label, BorderLayout.LINE_START);
20         text.addActionListener(this);
21         pack();
22         setVisible(true);
23     }
24
25     public void actionPerformed(ActionEvent event) {
26         label.setText("Text: "+text.getText());
27     }
28
29     public static void main(String[] args) {
30         SwingUtilities.invokeLater(new Runnable() {
31             public void run() {
32                 new GUI();
33             }
34         });
35     }
36 }
```

- The setTitle() method is called in line 16. Where is this method defined? (2 marks)
- What does the user have to do in order to get the text typed into the JTextField to appear in the JLabel? (2 marks)
- Draw a sketch that shows the regions defined by Border layout and label each region. (2 marks)
- Indicate on the sketch you drew in part c the approximate locations of the JTextField and JLabel components in this program. (2 marks)
- Describe briefly what the 'invokeLater' method does in line 30. (2 marks)

**END OF EXAMINATION**